2014 Cleveland Metroparks Hydrilla Report

Cleveland Metroparks Technical Report 2014/NR-03

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INTRODUCTION

Hydrilla verticillata is perhaps the most successful invasive aquatic plant in freshwater ecosystems. Hydrilla has been described as the perfect invasive plant because of its ability to thrive in a wide variety of aquatic habitats, grow in very low light conditions and in up to thirty feet of water, and its multiple pathways of propagation and reproduction that can persist in the environment for up to a decade (Batcher 2000; Langeland 1996). It is one of the most difficult and expensive submersed aquatic weeds to control, requiring multiple applications and multiple years of herbicide treatment (Netherland et al 1993). It spreads by seeds, stem fragments, tuberous roots in sediment, and by vegetative buds (turions) which form and float freely in the early autumn (Batcher 2000; Langeland 1996). Hydrilla is very difficult to detect at low numbers, but because of its rapid growth it can quickly overwhelm a waterbody and form dense, monotypic mats that out-compete native aquatic plants, reduce habitat for wildlife, and can severely impede recreational and other aquatic activities (Batcher 2000; Langeland 1996). It is easily spread by boats, waterfowl, humans, and other unsuspecting animals (Langeland 1996). It closely resembles the native aquatic plant *Elodea canadensis*, differing in having finely-toothed leaf margins visible to the naked eye and tuberous roots (Batcher 2000).

Hydrilla is abundant in the southeastern United States, where it was first introduced several decades ago by the aquarium and aquaculture trades, and is listed as a federal noxious weed (Batcher 2000; Langeland 1996). Hydrilla rapidly moved up the Atlantic seaboard following its introduction and has been found as isolated occurrences in states throughout the country (Batcher 2000; Langeland 1996). Recently, however, Hydrilla has begun moving westward, with established populations in and along the Ohio River and occurrences in Indiana, Pennsylvania, and New York (Menninger 2011) (Figure 1).

Hydrilla was first identified in Cleveland Metroparks in 2011 (Table 1). A single strand of Hydrilla was found in the Blue Heron Marsh in Ohio & Erie Canal Reservation by former Chief of Natural Resources John Mack in July (Table 1, Figure 2). In August, an abundant population was found in the Greathouse Wetlands in West Creek Reservation and a small population was found in the southern end of Wallace Lake in Mill Stream Run Reservation (Table 1, Figure 3, Figure 4). Parkwide surveys of potential Hydrilla habitat found infestations in Sunset Pond and Sanctuary Marsh in North Chagrin Reservation in 2012 and the Wash-Out Wetlands in West Creek Reservation in 2013

(Table 1, Figure 5, Figure 6). The Greathouse Wetlands is suspected to be the source population of Hydrilla in Cleveland Metroparks. Wetland plants were transferred from Greathouse to Blue Heron Marsh and Wallace Lake during 2009 and 2010 as part of a habitat enhancement project.

These were the first confirmed occurrences of Hydrilla in northern Ohio and the first in the Lake Erie watershed at the time (Figure 7). It is not known how widespread this plant is within or outside of the park district. Annual surveillance of potential habitats throughout Cleveland Metroparks has been conducted since 2012, but low densities of Hydrilla are difficult to detect and extremely dry or wet years can make surveys difficult. Contact with other invasive plant experts and lake treatment vendors working in northern Ohio who have been on the look-out for Hydrilla suggest that it is not presently wide-spread, however, lake vegetation surveys conducted by Cleveland State University located two confirmed and one suspected populations outside of Cleveland Metroparks during 2013.

INFESTATIONS

Sunset Pond, North Chagrin Reservation

Sunset Pond is a 5.2 acre man-made pond located in North Chagrin Reservation (Figure 5). The pond is a popular location for waterfowl, both local and migratory, and has been utilized as a broodstock source for game fish by Cleveland Metroparks. A water control structure is present between it and Sanctuary Marsh, which is located downstream. Hydrilla was found in the pond in 2012, consisting of several strands along the deck behind North Chagrin Nature Center. Subsequent surveys in 2013 failed to locate any Hydrilla; however, surveys were hampered by excessive algal growth present throughout the pond.

Sanctuary Marsh, North Chagrin Reservation

Sanctuary Marsh is a 3.7 acre created wetland located in North Chagrin Reservation (Figure 5). It is a popular location for local and migratory waterfowl and other wildlife, and is crossed by a boardwalk and used extensively by North Chagrin Nature Center staff for educational programming. It has a water control structure at its outflow to Buttermilk Creek, a tributary of the Chagrin River. Cleveland Metroparks has regularly conducted boat electrofishing to remove non-native goldfish from the marsh.

Hydrilla was found in the marsh in 2012, consisting of substantial mats in shallow areas around the boardwalk and the pond dipping dock.

Blue Heron Marsh, Ohio & Erie Canal Reservation

Blue Heron Marsh is consists of two hydrologically connected wetland cells that flow into the Ohio & Erie Canal, totaling 2.5 acres (Figure 2). Portions of the wetland have a boardwalk and pond-dipping dock, which is often utilized by CanalWay Visitor Center staff for educational programming. Additionally, a long-term Blanding's turtle study, including the release of young turtles and trapping and tracking, takes place in the wetlands. A single strand of Hydrilla was found in the wetland in 2011, subsequent surveys in 2012 and 2013 found numerous locations with multiple strands throughout the southern cell.

Greathouse Wetlands, West Creek Reservation

The Greathouse Wetlands consist of two hydrologically connected cells that total 1.14 acres (Figure 3). These man-made wetlands were built in 2002 and planted with nursery stock. There is a water control structure between the upper and lower cells and between the lower cell and West Creek. An extensive infestation of Hydrilla was found in the upper wetland cell in 2011, while the lower cell yielded a few clusters of the plant.

Wash-Out Wetlands, West Creek Reservation

The Wash-Out Wetlands consist of 9 hydrologically connected cells that were built along a 1300 foot sewer line wash-out in 2002, totaling 0.44 acres (Figure 6). The cells were planted with nursery stock. The wetlands were dry during the 2012 park-wide surveillance, but were inundated during the 2013 surveys, where Hydrilla was located in high densities throughout wetland cell seven (numbered 1-9 from south to north).

Wallace Lake, Mill Stream Run Reservation

Wallace Lake is the location of a former Berea sandstone quarry that was flooded and turned into a lake in the 1930's (Figure 4). It is 17.6 acres in size and, while it formerly was 50-60 feet deep, its current maximum depth is 26 feet due to decades of sedimentation. The lake consists of two deep basins to the north and south with a shallow, narrow connection between them. The lake has water level control structures that allow it to be drawn down. The lake empties into the East Branch Rocky River and, during high flood conditions, there can be unrestricted flow between the two waterbodies. The lake is used extensively for fishing, swimming, and kayaking and is managed during

the growing season for nuisance aquatic vegetation. Hydrilla was found in a few spots in the southern basin in 2011, but during 2012 it rapidly spread throughout the lake (Figure 8).

TREATMENTS

The treatment of Hydrilla for control and eradication is complex and challenging. Hydrilla is able to thrive in a wide variety of waterbodies and each site requires a unique treatment approach that takes into account numerous factors, from water depth and site hydrology to herbicide type and use restrictions (Batcher 2000; Langeland 1996). Cleveland Metroparks' primary method of Hydrilla control is herbicide treatment. Herbicides are the only method of treatment that can eliminate an infestation of Hydrilla. While other methods, such as mechanical removal and biological controls with grass carp, are management options, they primarily reduce biomass and do not control Hydrilla over the long term (Batcher 2000; Langeland 1996).

The majority of Hydrilla infestations in Cleveland Metroparks occur in wetland habitats, which present the challenge of treating Hydrilla while also maintaining native, desirable plant communities and using herbicides in an environment where they perform differently due to shallower water depths and variable seasonal hydrology. Cleveland Metroparks' approach to treating Hydrilla continues to evolve as it tests different herbicides, variations in application method, timing, and other controls, such as water draw-downs and barriers/filters, as well as from consultation with other agencies, manufacturers, and vendors.

2011 Treatments

Test plots (3x3 feet each) of Cutrine Plus (active ingredient copper sulfate) at 0.4 ppm and 0.2 ppm and Reward (active ingredient diquat dibromide) at the standard aquatic surface treatment rate were applied in separate locations in the upper Greathouse wetland cell to evaluate the effectiveness of the herbicides on Hydrilla. Cutrine Plus at both rates exhibited only moderate control of Hydrilla, with no by-kill, because Hydrilla is one of only a few vascular plants controlled by copper compounds. Reward exhibited better control, but also resulted in extensive damage to non-target native emergent plants because it is a broad-spectrum contact herbicide. A filter in the water control structure leading to West Creek in the lower cell was installed to prevent any vegetative fragments and turions from washing out of the wetland complex.

All Hydrilla that could be found in Wallace Lake, which was limited to the edge of the southern basin among the wetland plants transferred from the Greathouse wetlands in previous years, were spot-treated with Cutrine Plus during the late summer.

2012 Treatments

The Greathouse wetlands were spot treated with Cutrine Plus in May and early June. Hydrilla was dense and abundant in the upper cell and present in sparse strands in the lower cell. During the early June treatment it was noted that the Hydrilla was 50-75% dead in the areas treated in May. The Greathouse wetlands were treated again in late June, this time with Reward, and the Hydrilla was noted to still be abundant, especially in the upper cell. Treatment was difficult due to low water levels from planned dewatering of the wetlands and no further treatments were conducted in 2012 because the wetlands dried out.

Wallace Lake was spot treated for Hydrilla with Reward in May, where it was still limited to the edge of the southern basin and appeared greatly reduced from 2011 levels. Although the Hydrilla treated in May was gone, new areas of infestation in the southern basin were discovered in early June and treated with Cutrine Plus. Wallace Lake was treated twice in July, first with Cutrine Plus and then with Reward. Despite the earlier treatments Hydrilla continued to grow and spread, moving out of the southern basin to locations throughout the lake (Figure 8). Because of the continuing spread of Hydrilla in lake, including into the outflow channel leading to the East Branch Rocky River, despite repeated spot treatment of herbicide, a contractor was hired and whole-lake treatments using SonarAS (fluridone) were initiated in July and continued through October. Results of Sonar treatment were excellent, with Hydrilla bleaching and dying off throughout the lake.

2013 Treatments

2013 marked a shift in the treatment approach at the Greathouse wetlands. The wetlands were de-watered in early spring and a pre-emergent soil surface treatment of Galleon (penoxsulam) was applied throughout both cells. The wetlands were then allowed to refill during the late spring/early summer and a surface water treatment of Galleon was applied. The newly discovered infestation in the Wash-Out wetland cell was treated with a surface water application of Galleon in late summer.

A whole-lake treatment of Sonar from May-September was undertaken for the second year at Wallace Lake and results continued to be excellent, with no vegetative Hydrilla found anywhere in the lake during the growing season.

Sunset Pond in North Chagrin was beset by extensive filamentous algae growth during the spring and summer of 2013 and no Hydrilla was located, so only a single early summer preventive treatment was conducted to prevent the waste of expensive herbicide. Sanctuary Marsh was treated with SonarOne pellets (fluridone) by canoe a number of times during the growing season. While the target ppb rate was achieved and maintained, there was substantial non-target herbicide damage to the native emergent plants in the wetland.

MONITORING & SURVEILLANCE

Monitoring the effectiveness of herbicide treatments of Hydrilla is undertaken in three ways in Cleveland Metroparks- visual monitoring, water samples, and tuber sampling. Visual monitoring of treated waterbodies to track the growth, spread, and die-off of Hydrilla is regularly conducted by staff and contractors. This can be especially effective in areas where well-established populations of Hydrilla have been present to gauge how well treatments are working. However, on a larger scale, due to the ability of Hydrilla to grow in deep, murky water and spread via small fragments, it is less effective as it becomes difficult to visually detect. Water samples (FASTest, SEPro Corporation) to track the concentration of aquatic herbicides used to control Hydrilla are taken regularly during the treatment season, to ensure a minimum effective ppb of herbicide is maintained. Samples must be taken at regular intervals and from sites throughout the waterbody to effectively track herbicide concentrations so treatments can be planned.

In 2013 park staff began sampling Hydrilla tubers as a measurement of treatment effectiveness (the purpose of which is to both kill the vegetative Hydrilla during the growing season and prevent the formation of tubers for future growth) and determine the size of the tuber bank in infested waterbodies. Tuber samplers, as designed in Madsen et al (2007) and sorting screens were constructed in-house by Building Trades staff. Tuber sampling is a common monitoring method in Hydrilla control programs, but initial attempts by park staff have discovered a number of difficulties for sites in Cleveland Metroparks, including water depth and substrate composition issues (bedrock, gravel, or heavy clay in many areas), operation of the tuber samplers, and a lack of tubers found, even from areas where dense, multi-year infestations of Hydrilla are present.

Due to the widespread, scattered locations of known Hydrilla infestations in Cleveland Metroparks a park-wide surveillance of all potential aquatic habitats was conducted initially in the summer of 2012, and repeated and expanded in 2013 (Appendix A). It is anticipated that these annual parkwide surveys for Hydrilla will continue *ad infinitum* to allow staff to be able to rapidly respond to new infestations. Potential habitats surveyed include all lakes, ponds, and wetlands that remain at least partially inundated during the growing season. These surveys identified two new infestations in 2012 and one in 2013. Surveys are conducted by Natural Resources staff via boat and wading, depending on the habitat and water depth.

Cleveland Metroparks is cooperating with the Tri-State Aquatic Invasive Species Prevention and Monitoring project, led by The Nature Conservancy (TNC) and funded by US EPA GLRI grant EPA-R5-GL2012-1 in its efforts to monitor for Hydrilla and other aquatic invasive species across the Lake Erie shoreline.

DECONTAMINATION

Cleveland Metroparks Division of Natural Resources instituted a decontamination protocol for vehicles, equipment, and clothing used in the field in aquatic environments in 2012 after determining that field work activities were the primary cause of Hydrilla spread in the Park District. Decontamination has numerous benefits and should be a part of any field work protocol: not only can it prevent the spread of invasive species between sites; it can also prevent the transmission of a number of zoonotic diseases such as ranavirus and chytrid fungus. Decontamination stations were set up at Rocky River Management Center, Brecksville Maintenance Center, and the Watershed Stewardship Center at West Creek, consisting of 110 gallon tubs, scrub brushes, and bleach with a nearby water source and drainage that flows into either a catch basin or a sanitary sewer system. The protocol in its entirety can be found in Appendix B. Other local and regional agencies, including the Cuyahoga County Board of Health, have adopted the decontamination procedures for their own field activities.

INTERNAL COOPERATION

Intradepartmental cooperation in Cleveland Metroparks has been pivotal in the Park District's efforts to institute an effective Hydrilla control and monitoring program. Park Management, Natural Resources, Outdoor Education and Recreation, and Rangers came together in several internal meetings to collaborate on appropriate and effective methods for Hydrilla control and to ensure information was disseminated to the appropriate staff.

The spread of Hydrilla throughout Wallace Lake during the summer of 2012 prompted Cleveland Metroparks to institute recreational restrictions to prevent spread to additional waterbodies in and around the Park District. Wallace Lake is extremely popular for swimming, boating (paddleboats, kayaks, canoes, rowboats), and fishing, and is used heavily by both the public and by staff for programs. An internal meeting was held and staff decided to ban all fishing and external boating at Wallace Lake, as those were the two activities with the greatest potential for spreading Hydrilla. Signage was placed around the lake, particularly at access points, letters were sent to adjacent homeowners, and press releases were distributed to the local media. Internal boating was permitted because movement between areas was only done after boats were decontaminated. The restrictions were enforced by Cleveland Metroparks Rangers. The fishing prohibition was lifted in December to allow for the regular ice fishing season, which was deemed low-risk since the vegetative Hydrilla had died back. Boating restrictions were carried through the end of 2012.

Restrictions were discussed for 2013, but staff decided that they would only be instituted if vegetative Hydrilla was detected in the lake. The lake was routinely monitored by both staff and the contractor carrying out treatments and no Hydrilla was detected during the growing season.

PUBLIC OUTREACH

Since discovering Hydrilla, Cleveland Metroparks has consulted and collaborated with numerous other agencies, contractors, and vendors to determine the best approaches to eradication, monitoring, and treatment both within its boundaries and in the Great Lakes region as a whole. Outdoor Education and Recreation staff have incorporated

Hydrilla into many of their public programs on wetlands, invasive species, and water-based recreation.

Cleveland Metroparks staff has given presentations on Hydrilla at a meeting of the Midwest Aquatic Plant Management Society and the Ohio Woodland, Water, & Wildlife Conference, both in March 2013. Park District staff also attended a multi-state, multi-agency discussion on the management of nuisance aquatic species with a focus on Hydrilla in the Ohio River basin in June 2013.

Cleveland Metroparks hosted a Hydrilla workshop on April 23, 2013 at North Chagrin Nature Center, North Chagrin Reservation. The workshop was sponsored in part by the Crooked River Cooperative Weed Management Area, Great Lakes United, and the Ohio Invasive Plants Council. The day-long workshop focused on the early detection and rapid response to Hydrilla infestations, with the goal of encouraging regional surveys for Hydrilla and developing connections among diverse organizations with a shared interest in preventing the spread of aquatic nuisance species. Cleveland Metroparks staff presented during the morning session on the ecology of Hydrilla, identification and vouching of Hydrilla and other submersed aquatic plants, and the methods Cleveland Metroparks has developed to survey for and monitor Hydrilla and decontamination procedures. The afternoon session consisted of presentations on invasive plant mapping and citizen science, aquatic interstate surveillance, and control and management of Hydrilla. The workshop was attended by 43 participants from four states and sixteen organizations.

Location and occurrence information for each Hydrilla infestation in Cleveland Metroparks will be submitted to the Early Detection and Distribution Mapping System (EDDMapS; http://www.eddmaps.org)) and Great Lakes Early Detection Network (GLEDN; http://www.gledn.org) websites. EDDMapS and GLEDN are web-based mapping systems for documenting invasive species distribution in the United States and Canada. These websites allow participants to submit observations, which are verified to ensure accuracy, and view data from throughout the United States. Data is available almost immediately after submission, allowing real-time tracking of species movement and helping to facilitate early detection and rapid response programs. Cleveland Metroparks will continue to collaborate with these and other agencies to facilitate ongoing communications, data sharing, and evaluation of its Hydrilla program.

COSTS

(See Appendix C)

Hydrilla is costly to control because of the multi-faceted, long-term approach required to eliminate it. The herbicides needed to effectively treat Hydrilla while minimizing damage to non-target aquatic plants are costly even in small quantities and completely eliminating a population from a waterbody requires up to a decade of treatment, with a specific concentration of herbicide maintained throughout the growing season (Batcher 2000; Netherland et al 1993). Adding to the expense is that each infestation is unique and requires a treatment approach tailored to the individual waterbody. Additionally, staff time needed to conduct and monitor treatments and carry out annual surveillance of potential habitats has increased annually as more infestations are located and habitats at risk are identified. Between November 2012 and December 2013 Cleveland Metroparks spent $6,384 on Hydrilla-specific herbicides and this amount will increase annually as herbicide prices increase, additional infestations are identified, and treatment plans develop.

Cleveland Metroparks has entered into a subsidy agreement with the Ohio Division of Natural Resources (ODNR) for 2012, 2013, and 2014. ODNR is providing 75% of the funding for the Wallace Lake Hydrilla treatment and monitoring contract via funds they received under a Great Lakes Restoration Initiative (GLRI) grant.

Cleveland Metroparks applied for a GLRI grant (EPA-R5-GL2013-1, Category I.B. - Invasive Species Prevention and Control) through the US EPA in August 2013, titled “Hydrilla Eradication & Prevention in the Lake Erie Drainage.” The grant requested $385,000 in funding with a $15,000 match (in staff time), which would allow Cleveland Metroparks to expand its Hydrilla eradication and detection program to prevent further spread of this aquatic invasive species in the Park District and to surrounding areas. A framework for Hydrilla monitoring and rapid response in Ohio’s Lake Erie basin, including treatment guidelines and mapping of high-risk areas, would be developed to protect the Great Lakes ecosystem. Information gathered from this project would be shared via online databases and professional and public outreach and education efforts. Cleveland Metroparks was notified in late December that its application was not selected for funding, but Natural Resources staff plan to reapply for the 2014 grant season if another round of GLRI or similar funding becomes available.

While Hydrilla treatment and monitoring in Cleveland Metroparks is costly in both herbicides and staff time, the cost of not controlling this invasive aquatic plant is even greater. If allowed to grow unchecked in its waterbodies, Hydrilla will degrade important aquatic habitat in the Park District's lakes, ponds, and wetlands. Hydrilla could form dense mats in recreational areas, making swimming, fishing, and boating all but impossible in areas like Wallace Lake. The risk of Hydrilla spreading to additional areas both within and outside the Park District is extremely high if infestations are not identified early and treated effectively. As the location of the first known infestations of Hydrilla in the Lake Erie drainage in Ohio it is incumbent upon Cleveland Metroparks as a conservation agency to proactively and responsibility manage this invasive species to protect the natural resources of both the Park District and the region as a whole.

2014 TREATMENT PLANS

(See Appendix D)

Sunset Pond, North Chagrin Reservation

SonarAS treatments beginning in mid-May and continuing into early October. Initial treatment level of 10.0 ppb, with a maintained level of 7.5 ppb throughout the treatment season.

Sanctuary Marsh, North Chagrin Reservation

Sonar AS treatments beginning in mid-May and continuing into early October. Initial treatment level of 10.0 ppb, with a maintained level of 7.5 ppb throughout the treatment season.

Blue Heron Marsh, Ohio & Erie Canal Reservation

Initial treatment with Galleon (penoxsulam) in early May, followed by SonarOne treatments from mid-May through early October. First SonarOne treatment at 10 ppb, subsequent treatments at 7.5 ppb.

Greathouse Wetlands, West Creek Reservation

Both wetland cells will be de-watered in early spring. Initial treatment with Galleon (penoxsulam) in early May, applied as a pre-emergent soil treatment. SonarOne treatments as surface water applications will be conducted from mid-May through early October. First SonarOne treatment at 10 ppb, subsequent treatments at 7.5 ppb.

Wash-Out Wetlands, West Creek Reservation

Initial treatment with Galleon (penoxsulam) in early May, followed by SonarOne treatments from mid-May through early October. First SonarOne treatment at 10 ppb, subsequent treatments at 7.5 ppb.

Wallace Lake, Mill Stream Run Reservation

Initial treatment with Galleon (penoxsulam) in early May, followed by SonarOne treatments from mid-May through early October. First SonarOne treatment at 10 ppb, subsequent treatments at 7.5 ppb.

LITERATURE CITED

Batcher, M.S. 2000. Element Stewardship Abstract for *Hydrilla verticillata* (L.F.) Royle, Hydrilla. The Nature Conservancy, Wildland Invasive Species Team. Arlington, VA. Available at http://www.imapinvasives.org/GIST/ESA/esapages/documnts/hydrver.pdf

Langeland, K.A. 1996. Hydrilla verticillata (L.F.) Royle (Hydrocharitaceae), "The Perfect Aquatic Weed". Castanea 61:293-304.

Madsen, J.D., R.M. Wersal and T.E. Woolf. 2007. A New Core Sampler for Estimating Biomass of Submersed Aquatic Macrophytes. J. Aquat. Plant Manage. 45:31-34.

Menninger, H. 2011. Hydrilla verticillata in the Cayuga Inlet: A science‐based review to guide management actions. NY Invasive Species Research Institute, Cornell University, Ithaca, NY. 11 pp.

Netherland, M.D., K.D. Getsinger and E.G. Turner. 1993. Fluridone Concentration and Exposure Time Requirements for Control of Eurasian Watermilfoil and Hydrilla. J. Aquat. Plant Manage. 31:189-194.

TABLES AND FIGURES

Table 1. Locations of Hydrilla in Cleveland Metroparks.

Site Name	Size (acres)	Reservation	Watershed	County	Hydrilla Found
Sunset Pond	5.20 acres	North Chagrin	Chagrin River	Cuyahoga	2012
Sanctuary Marsh	3.70 acres	North Chagrin	Chagrin River	Cuyahoga	2012
Blue Heron Marsh	2.50 acres	Ohio & Erie Canal	Cuyahoga River	Cuyahoga	2011
Greathouse Wetlands	1.14 acres	West Creek	Cuyahoga River	Cuyahoga	2011
Wash-Out Wetlands	0.44 acres	West Creek	Cuyahoga River	Cuyahoga	2013
Wallace Lake	17.60 acres	Mill Stream Run	Rocky River	Cuyahoga	2011

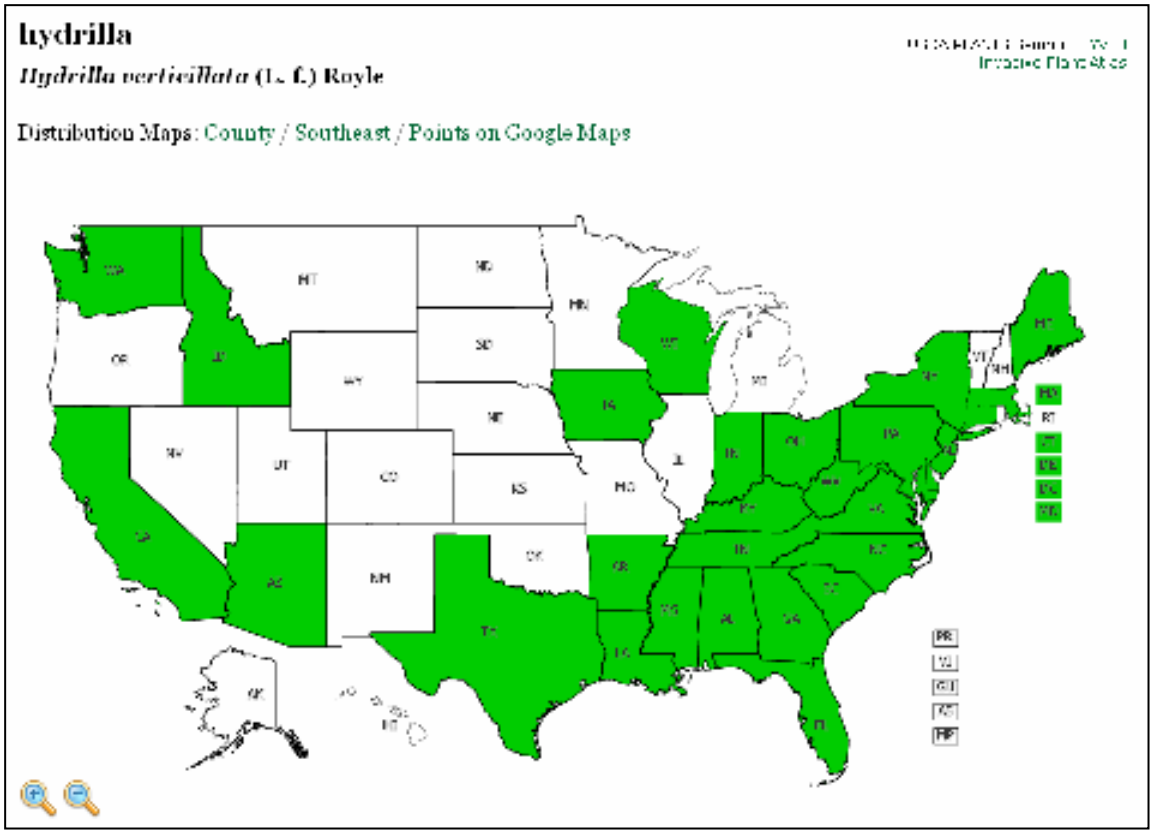

Figure 1. Distribution map of Hydrilla in the United States.

Figure 2. Map of the Blue Heron wetlands in Ohio & Erie Canal Reservation

Figure 3. Map of the Greathouse Wetlands in West Creek Reservation

Figure 4. Map of Wallace Lake in Mill Stream Run Reservation.

Figure 5. Map of Sanctuary Marsh and Sunset Pond in North Chagrin Reservation.

Figure 6. Map of the Wash-Out Wetlands in West Creek Reservation.

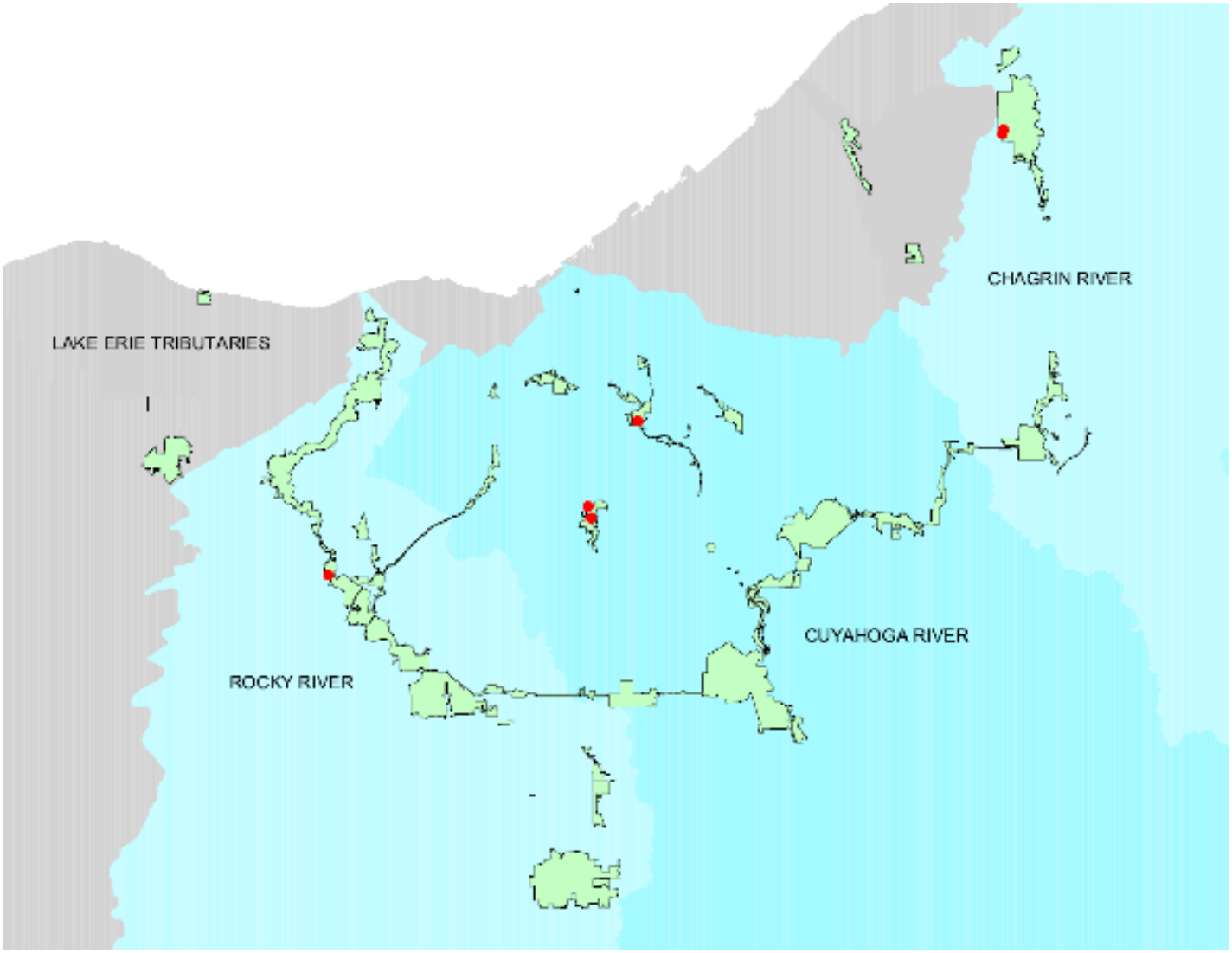

Figure 7. Map of Hydrilla infestations in Cleveland Metroparks and its watersheds.

Figure 8. The spread of Hydrilla in Wallace Lake in 2012.

APPENDICES

Appendix A: Hydrilla Surveillance Sites in Cleveland Metroparks

Reservation	Site Location
Acacia	Large pond on northwestern edge
	Small central pond
	Pond on eastern edge by development
Bedford	Circle Emerald ponds (2)
	Shawnee golf course ponds (2)
	Small pond off Gorge Parkway
Big Creek	Upper wetland and ponds off parkway split
	Lake Isaac
	Beyer's Pond
	Small ponds around Beyer's Pond
	Fowles Marsh
	Lake Abram wetland complex
	Wetland off L2L trail by Hepburn
	Wetlands off gravel trail NW of Lake Isaac
	Small wetland to SE of Lake Abram
	Dipping pond at Eastland trailhead
Bradley Woods	Bunn's Lake/Wildlife complex
	Wetland N of White Oak Drive
	Wetland on E/central edge of reservation
Brecksville	York Road pond
	Seneca golf course ponds (2)
	Seneca vernal pool in wooded E edge
	Sleepy Hollow golf course pond
	Ponds by management center (2)
	Chippewa mitigation wetlands
	Riverview N wetlands
	Riverview S wetlands
Brookside & Zoo	Upper created vernal pools
	Goldfish ponds
	Lower created vernal pools
	Waterfowl Lake
	AEC pool
Garfield Park	Old boating pond
Hinckley	Hinckley Lake
	Judges Lake
	Wetlands W of Judges Lake
	Ledge Lake and upper pond
	Brooklyn Exchange ponds (2)
	Rising Valley wetland complex

Reservation	Site Location
Mill Stream Run	Wallace Lake
	Wallace Lake outflow stream
	Baldwin Lake
	Handle Road wetlands
	Whitney Road wetlands
	Wintergreen ponds (3)
	Bonnie Park ponds (2)
	Ranger Lake
	Strongsville Wildlife Area wetlands
	Oxbow opposite Strongsville Wildlife
	Wetland pond N of Chalet
	Moose Pond/Camp Cheerful
	Oxbow across Royalview Road entrance
	W 130th wetlands
	Drake Road wetlands
	Wetland/channel from mgmt center wash area
North Chagrin	Manakiki golf course ponds (3)
	Sunset Pond
	Sanctuary Marsh
	Strawberry Pond
	Oxbow
	Dinger's Marsh
	Foster's Run mitigation wetlands
	Wilson Mills/Chagrin River Rd wetlands (2 cells)
Ohio & Erie Canal	Slag ponds (2)
	Small pond off APT
	Blue Heron Marsh (2 cells)
	Ohio & Erie Canal (esp. fishing area, kayak docks)
Rocky River	Kason Swamp
	Big Met wetlands (across from POA)
	Big Met pond
	RRNC wetlands
	RRNC old oxbow
	Cedar Point wetlands off loop trail
	Oxbow Lagoon
South Chagrin	Shadow Lake
	Management center ponds (2)
	Squaw Rock pond
	Sulphur Springs vernal pool
Washington	Wetlands on golf course (2 cells)
West Creek	West Ridgewood wetland
	Greathouse wetlands (2 cells)
	Wash-out wetlands by sewer line

Appendix B: Cleveland Metroparks Decontamination Protocol

Standard Operating Procedure (SOP) for Foot Based Field Work
For any field work involving foot travel to aquatic sites, including but not limited to wading, the following three prong decontamination approach will apply.

1) *Visual inspection and removal of living and non-living matter from field equipment.* Upon completing field work at an aquatic site, the personnel will observe all equipment and do their best to remove all mud, vegetative matter, and excessive water from field equipment. Dedicated scrub brushes should be included with field equipment for this purpose. Initial cleaning can involve rinsing with water available in the field.

2) *Rinse equipment with clean water.* Upon changing watersheds or before moving to a sensitive habitat the personnel will rinse all field equipment used at the site with clean tap water. For field based rinsing, at least one five gallon container of clean tap water should be included with field equipment for use at the vehicle. For rinsing at the end of the field day, the hot water pressure washer at the car wash bay at the Rocky River Management Center will be used. There will also be locations at Brecksville Garage and West Creek Watershed Stewardship Center for rinsing.

3) *Rinse/soak equipment in 2% bleach solution.* Research into biological decontamination protocols for various other agencies (Ohio DNR, Maine DEP, NYC DEP, and British Columbia Ministry of Environment) reveal that use of household bleach is a cheap, effective, and readily available agent for biological decontamination for a wide range of potentially pathogenic agents. A concentration of 4 oz of bleach for 1 gallon of clean tap water is commonly used and proven effective, and will also be used in this procedure. For travel between subwatersheds, or before moving to a sensitive site, a dedicated backpack sprayer containing 2% bleach solution will be used to saturate all exposed equipment at least 100 feet from the aquatic habitat and allowed to air dry before changing sites. For decontamination at the end of the field day, stations will be available at the Rocky River Management Center car wash bay, Brecksville Garage, and West Creek Watershed Stewardship Center for soaking exposed field equipment in a 2% bleach solution for no less than one minute, and then allowed to air dry overnight before re-use.

Standard Operating Procedure (SOP) for Boat or ATV Based Field Work
For any field work involving use of watercraft, or ATV (including the Argo) at aquatic sites, the following two tiered decontamination approach will apply for decontamination in addition to the aforementioned protocol for other field equipment and clothing.

1) *Visual inspection and removal of living and non-living matter from boat, boat trailer and/or ATV*. Upon completing field work at an aquatic site, the personnel will observe the boat, boat trailer, and/or ATV and do their best to remove all mud, vegetative matter, and excessive water from field equipment. Dedicated scrub brushes should be included with field equipment for this purpose. Initial cleaning can involve rinsing with water available in the field.

2) *Hose or pressure wash vehicles and trailers with clean tap water.* At the end of the field day, the boat, boat trailer, and/or Argo will be thoroughly cleaned with a hose or pressure washer at a maintenance facility, and all water will be drained from the equipment. All equipment will be allowed to air dry at least overnight before re-use.

Special Circumstances

The protocols outlined are expected to apply to the majority of routine field work, but special circumstances will certainly arise that require specific attention. These will include work in sites with known pathogens or especially sensitive habitats. These circumstances will require situation specific attention, but in many cases the same protocol as already listed will apply with the exception of including a minimum of 15 minute soak in the 2% bleach solution.

Appendix C: Hydrilla Treatment Costs 2011-2013

2011 Hydrilla Treatment Costs

Location	Reward		Cutrine Plus		Contractor		SonarAS	SonarOne	Galleon	FasTest		
Wallace Lake			1.0 gal									
Greathouse	24.0 oz		8.0 oz									
	Reward $	$16.80	**Cutrine Plus $**	$22.30	**Contractor $**		**SonarAS $**	**SonarOne $**	**Galleon $**	**FasTest $**	**Total $**	**$39.10**

2012 Hydrilla Treatment Costs

Location	Reward		Cutrine Plus		Contractor**		SonarAS	SonarOne	Galleon	FasTest		
Wallace Lake	2.25 gal		8.0 gal		July-October							
Greathouse	4.0 gal		5.1 gal									
	Reward $	$493.85	**Cutrine Plus $**	$288.18	**Contractor $**	$2,012.00	**SonarAS $**	**SonarOne $**	**Galleon $**	**FasTest $**	**Total $**	**$2,794.02**

2013 Hydrilla Treatment Costs

Location	Reward		Cutrine Plus		Contractor**		SonarAS	SonarOne		Galleon		FasTest*		
Wallace Lake					May-October									
Greathouse										16.3 oz		4		
Wash-Out										0.92 oz		1		
Sunset								5.8 lbs						
Sanctuary								13.76 lbs				1		
	Reward $		**Cutrine Plus $**		**Contractor $**	$11,325.00	**SonarAS $**	**SonarOne $**	$548.46	**Galleon $**	$282.93	**FasTest $**	$664.00	**Total $** **$12,820.39**

*FasTEST including shipping costs
**ODNR covering 75% of contractor costs

Appendix D: 2014 Hydrilla Treatment Plan and Cost Estimates

Hydrilla Treatment Plan for 2014
(Source - Hillmer & Weldon)

Later start - deeper, cooler water

	Approximate Date	15-May	29-May	12-Jun	26-Jun	10-Jul	24-Jul	7-Aug	21-Aug	4-Sep	18-Sep	2-Oct	
	week #	0	2	4	6	8	10	12	14	16	18	20	
													Total Sonar AS (fl.oz.)
	PRODUCT	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	
Sanctuary Marsh	Ounces Applied	8.8	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	75.0
	ppb applied	10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
											total ppb	*85*	
Sunset Pond	Approximate Date	15-May	29-May	12-Jun	26-Jun	10-Jul	24-Jul	7-Aug	21-Aug	4-Sep	18-Sep	2-Oct	
	week #	0	2	4	6	8	10	12	14	16	18	20	
	PRODUCT	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	Sonar AS	
	Ounces Applied	9.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	79.5
	ppb applied	10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
											total ppb	*85*	154.5

West Creek, Ohio & Erie Canal Reservations

Substrate + Pellet program

Earlier start - shallow, warmer water

	Approximate Date	1-May	15-May	29-May	12-Jun	26-Jun	10-Jul	24-Jul	7-Aug	21-Aug	4-Sep	18-Sep	2-Oct		
	week #	0	2	4	6	8	10	12	14	16	18	20	22		
														Total Galleon (fl.oz)	Total Sonar One (lb.)
Greathouse Upper Basin	PRODUCT	Galleon SC	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One		
	Amt. Applied	8.01	0.36	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	8.0	3.06
	ppb applied	(11.2 0z/A)	10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5		
		fl.oz.	lb.									*total ppb*	*85*		
	Approximate Date	1-May	15-May	29-May	12-Jun	26-Jun	10-Jul	24-Jul	7-Aug	21-Aug	4-Sep	18-Sep	2-Oct		
Greathouse Lower Basin	PRODUCT	Galleon SC	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One		
	week #	0	2	4	6	8	10	12	14	16	18	20	22		
	PoundsApplied	4.79	0.26	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	4.8	2.26
	ppb applied	(11.2 0z/A)	10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5		
		fl.oz.	lb.									*total ppb*	*85*		
	Approximate Date	1-May	15-May	29-May	12-Jun	26-Jun	10-Jul	24-Jul	7-Aug	21-Aug	4-Sep	18-Sep	2-Oct		
Washout #7	PRODUCT	Galleon SC	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One		
	week #	0	2	4	6	8	10	12	14	16	18	20	22		
	PoundsApplied	0.62	0.09	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.6	0.79
	ppb applied	(11.2 0z/A)	10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5		
		fl.oz.	lb.									*total ppb*	*85*		
	Approximate Date	1-May	15-May	29-May	12-Jun	26-Jun	10-Jul	24-Jul	7-Aug	21-Aug	4-Sep	18-Sep	2-Oct		
Blue Heron Marsh	PRODUCT	Galleon SC	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One	Sonar One		
	week #	0	2	4	6	8	10	12	14	16	18	20	22		
	PoundsApplied	14.00	1.69	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	14.0	14.29
	ppb applied	(11.2 0z/A)	10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5		
		fl.oz.	lb.									*total ppb*	*85*		
														27.4 fl.oz.	20.40 lb.

Water body	surface acres	average depth (ft)	acre-feet	target rate (ppb)	herbicide name	herbicide cost (lb. or oz.)	Initial treatment (lb. or oz.)	bumps	Subtotal herbicide qty (lb. or oz.)	Herbicide subtotal*	# sample points	# assays	Cost per test $	Subtotal Test $	Subtotal Material/Tests (30%)	Mobilization 70% *(Wallace), 25%** additional to add	Total Cost
Sanctuary Marsh	3.74	2.73	10.21	7.5	Sonar One	$ 28.04	5.5	41	46.5	$ 1,303.86	1	11	$ 90.00	$ 990.00	$ 2,293.86	$ 764.62	$ 3,058.48
Sunset Pond	5.22	2.07	10.81	7.5	Sonar One	$ 28.04	5.8	44	49.8	$ 1,396.39	1	11	$ 90.00	$ 990.00	$ 2,386.39	$ 795.46	$ 3,181.86
															$ 4,680.25		
Greathouse Wetlands - Upper Basin	0.715	0.94	0.672	7.5	Sonar One	$ 28.04	0.36	2.97	3.33	*$ 93.37*	1	11	$ 90.00	$ 990.00	$ 1,083.37	$ 361.12	$ 1,444.50
Greathouse Wetlands - Lower Basin	0.428	1.13	0.484	7.5	Sonar One	$ 28.04	0.26	2.2	2.46	*$ 68.98*	1	11	$ 90.00	$ 990.00	$ 1,058.98	$ 352.99	$ 1,411.97
Washout Wetland # 7	0.055	3	0.165	7.5	Sonar One	$ 28.04	0.09	0.77	0.86	*$ 24.11*	1	11	$ 90.00	$ 990.00	$ 1,014.11	$ 338.04	$ 1,352.15
Blue Heron Marsh (2 cells connected)	1.25	2.5	3.13	7.5	Sonar One	$ 28.04	1.69	13.86	15.55	*$ 436.02*	1	11	$ 90.00	$ 990.00	$ 1,426.02	$ 475.34	$ 1,901.36
										$ 622.49				*$ 3,960.00*	*$ 4,582.49*	*$ 1,527.50*	*$ 6,109.98*
Greathouse Wetlands - Upper Basin	0.715	0.94	0.672	7.5	Galleon SC	$ 16.00	8.01	8.8	16.81	$ 268.96	1	11	$ 104.00	$ 1,144.00	$ 1,412.96	$ 470.99	$ 1,883.95
Greathouse Wetlands - Lower Basin	0.428	1.13	0.484	7.5	Galleon SC	$ 16.00	4.79	6.3	11.09	$ 177.44	1	11	$ 104.00	$ 1,144.00	$ 1,321.44	$ 440.48	$ 1,761.92
Washout Wetland # 7	0.055	3	0.165	7.5	Galleon SC	$ 16.00	0.62	2.1	2.72	$ 43.52	1	11	$ 104.00	$ 1,144.00	$ 1,187.52	$ 395.84	$ 1,583.36
Blue Heron Marsh (2 cells connected)	1.25	2.5	3.13	7.5	Galleon SC	$ 16.00	14	40.8	54.8	$ 876.80	1	11	$ 104.00	$ 1,144.00	$ 2,020.80	$ 673.60	$ 2,694.40
										$ 1,366.72				*$ 4,576.00*	*$ 5,942.72*	*$ 1,980.91*	*$ 7,923.63*
Wallace Lake	17.5	10	175.00	6	Sonar AS"	$ 13.27	90.72	22.68	113.4	$ 1,504.82	2	11	$90	$ 1,980.00	**$ 3,484.82**	$ 8,131.24	$ 11,616.06

* Sonar One sold by 20-lb pail ($560.80) in 2013 $ 28.04
** Galleon sold by the quart ($512) in 2013 $ 16.00
*** Sonar AS sold by the gallon ($1698) in 2013 $ 13.27

* fluridone $88 in 2013
** penoxsulam $100 in 2013

*70% for Wallace Lake
20% if adding wetlands to Wallace Lake contract